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**X-RAY APPARATUS, ESPECIALLY MAMMOGRAPHIC X-RAY APPARATUS,
COMPRISING INDICATING MEANS IN THE FORM OF LEDS**

[0001] The invention relates to an X-ray apparatus, in particular a mammographic X-ray apparatus, as generically defined by the preamble to claim 1 and as defined by the preamble to claim 2; an X-ray apparatus of this kind is known from German Patent Disclosure DE 199 43 898 A1.

[0002] Mammographic X-ray apparatuses have indicator means, by which, before the actual process of taking the X-ray images, the X-ray field projected on the surface of a patient body and/or on an object table is monitored, for instance to assure that the correct diaphragm has been chosen. As the indicator means, an incandescent bulb mounted laterally of the X-ray beam path is typically provided. The beam of light from the incandescent bulb, extending perpendicular to the X-ray beam, is deflected into the direction of the X-ray beam by a mirror disposed in the X-ray beam path. In the actual taking of the image, the mirror is folded out of the way of the beam path, or if it is radiotransparent, it stays in the beam path.

[0003] From DE 199 43 898 A1, particularly for X-ray apparatuses used as aids in surgery, indicator means in the form of laser diodes are known, which are mounted either on the X-ray detector or on the X-ray source, in order to make the region, through which the X-radiation passes, above the surface of the patient and/or the X-ray field on the surface of the patient visible (illuminated). The indicator means are designed to be adaptable to the geometry of the X-ray beam, and especially the size of the opening angle, for instance by sending a signal for changing the aperture of the diaphragm onward to the indicator means.

[0004] The object of the present invention, in such X-ray apparatuses and in particular mammographic X-ray apparatuses, is to make the illumination of the X-ray field, which precedes making the images themselves, simpler in a way that involves less effort.

[0005] Attaining this object can be done in an X-ray apparatus, in particular a mammographic X-ray apparatus, as generically defined by the preamble to claim 1 or to claim 2 by means of their respective definitive teachings; advantageous features are each the subject of the associated dependent claims.

[0006] The X-ray apparatus, in particular a mammographic X-ray apparatus, of the invention, because of the mounting of the indicator means between the X-ray source and the diaphragm and because of the undeflected orientation of the illuminating beam, offers the advantage that the diaphragm is not also used for shaping the beam of the X-ray beam and shaping the beam of the illuminating beam but instead, deflecting the illuminating beam can be dispensed with. Complicated control of the orientation of the indicator means is eliminated, and a mirror that can be folded away is unnecessary, making a compact, low-maintenance construction possible.

[0007] In a way that is advantageous for the sake of a compact, simple construction of the X-ray apparatus, the at least one LED is mounted on a filter array that is associated with the X-ray apparatus and is located between the X-ray source and the diaphragm. Since in most X-ray apparatuses (systems) the filter array is fundamentally present, all that is needed is a mount for the LED. If there are a plurality of LEDs surrounding the X-ray beam, then the LEDs are disposed on a common ring mount, in a way that is expedient for the sake of especially simple mounting.

[0008] The invention as well as further advantageous features along with characteristics of the dependent claims will be described in further detail below in terms of exemplary embodiments shown schematically in the drawings; shown are:

[0009] Fig. 1, in a side view, a known mammographic X-ray apparatus with an incandescent bulb and deflection mirror for illuminating an X-ray field;

[0010] Fig. 2, in a side view, a mammographic X-ray apparatus of the invention, with a plurality of LEDs on a ring mount for illuminating the X-ray field;

[0011] Fig. 3, in plan view, the ring mount of Fig. 2;

[0012] Fig. 4, in a side view, a mammographic X-ray apparatus of the invention having at least one LED on a filter array for illuminating the X-ray field;

[0013] Fig. 5, in a detailed view, a filter array of Fig. 4, with at least one LED.

[0014] Fig. 1 shows a known mammographic X-ray apparatus 1, which as its essential components includes both an X-ray source 5 and a detector, in particular an object table 2 equipped with an X-ray film. In an examination, the X-ray source 5 generates an X-ray beam 11, which serves to project an object (image), not explicitly shown, of a patient, which is to be examined, onto the detector. A diaphragm 4 is disposed such that it can delimit the X-ray beam 11 by blanking out (blocking) some portions. Before an actual operation of making an X-ray image, an X-ray beam on the surface of the patient or on the object table 2 is monitored by means of an illuminating beam 7 that is generated by an incandescent bulb 12 and deflected by a mirror 13 in the direction of the X-ray field. The incandescent bulb 12 and the mirror 13 are adjusted in such a way that the illuminating beam 7 and the X-ray beam 11 are essentially congruent on the surface of the patient or on the object table 2. The mirror 13, in order not to hinder the X-ray beam 11, is either radiotransparent or can be folded out of the way of the X-ray beam 11.

[0015] Fig. 2 shows a mammographic X-ray apparatus 1.1 of the invention, in which a plurality of LEDs 6 are disposed between an X-ray source 5.1 and a diaphragm 4.1, and the illuminating beam 7.1 is directed in an undeflected fashion onto the X-ray field. The term "undeflected" does not preclude the use of lenses for correcting the illuminating beam within a range of up to 15°. The illuminating beam 7.1 is delimited by the diaphragm, by the positioning of the LEDs between the X-ray source 5.1 and the diaphragm 4.1, in such a way that the beam field of the illuminating beam on the surface of the patient and/or on the object table 2.1 is essentially congruent with the X-ray field of the X-ray beam 11.1. The LEDs are disposed outside the X-ray beam 11.1, distributed over its outer circumference, so

that they neither damage the X-ray beam nor become damaged themselves by it. Advantageously, the LEDs are disposed on a common ring mount 10.

[0016] Fig. 3 shows a detailed plan view on one such ring mount 10 with individual LEDs 6 and on the X-ray source 5.1 and on the X-ray beam 11.1, which is shown in cross section at the level of the ring mount 10. The ring mount 10 is embodied and mounted in such a way that the X-ray beam 11.1 can pass through its center unhindered.

[0017] Fig. 4 shows an X-ray apparatus 1.2, as a second embodiment of the invention, with the mounting of at least one LED 6.2 on a filter array 3 that is present per se. For the sake of greater brightness, a plurality of LEDs may also be provided. The filter array 3, which is mounted between the X-ray source 5.2 and the diaphragm 4.2, typically serves to move individual filters 8.1; 8.2; 8.3 into the X-ray beam for filtering out frequencies not needed for the particular X-ray image to be made. The at least one LED 6.2 can advantageously be positioned in the filter array 3, in particular instead of a filter 8.1; 8.2; 8.3, and can be pivoted (swiveled) out of the X-ray beam 11.2. For illuminating the X-ray field, the filter array 3 is pivoted (swiveled) in such a way that the at least one LED 6.2 is located exactly in the beam path of the X-ray beam 11.2, and the illuminating beam 7.2 is essentially congruent with the X-ray beam 11.2. Expediently, the at least one LED 6.2 is pivotable (swivable) out of the X-ray beam 11.2 by rotation of the filter array 3 about its longitudinal axis. For making the X-ray image, the required filters (8.1; 8.2; 8.3) can be pivoted (swiveled) into the beam path instead of the LEDs.

[0018] Fig. 5 shows a more-detailed view of a filter array 3, shown schematically in Fig. 4, with four mounts intended for filters or LEDs, three individual filters (8.1; 8.2; 8.3) inserted into mounts, and at least one LED 6.2 that is disposed in a mount in place of one filter.

[0019] The invention can be summarized briefly as follows: In an X-ray apparatus, in particular a mammographic X-ray apparatus, having an X-ray beam generated by an X-ray source and delimitable by a diaphragm, for the sake of

illuminating an X-ray field on the surface of a patient with little effort, LEDs are disposed as indicator means outside the X-ray beam and distributed over its outer circumference, between the X-ray source and the diaphragm, and the illuminating beam of the LEDs is directed in an undeflected fashion onto the X-ray field; in a further version of the invention, at least one LED is mounted, in such a way that it can be pivoted out of the X-ray beam, on a filter array that is mounted between the X-ray source and the diaphragm.